Berkeley Experiments with Accelerated Radioactive Species

J. Powell, R. Joosten, C. A. Donahue†, R. F. Fairchild†, J. Fujisawa, F. Q. Guo, P. E. Haustein‡, R.-M. Larimer, C. M. Lyneis, P. McMahan, E. B. Norman, J. P. O'Neil§, M. W. Rowe, H. F. VanBrocklin§, D. Wutte, X. J. Xu and Joseph Cerny

Berkeley Experiments with Accelerated Radioactive Species (BEARS), is a program to develop radioactive beams at the 88-Inch Cyclotron by utilizing isotopes produced by the Biomedical Isotope Facility (BIF) of the Life Sciences Division [1,2]. In 1999, the complete BEARS system was constructed and commissioned, producing an intensity of the initial beam, ^{11}C, of around 10^8 ions/second on target [3]. This intensity, more than an order of magnitude higher than was expected when the project was initially proposed in 1997, is very competitive with other radioactive beam facilities around the world.

The BEARS system starts with isotope production at BIF. This facility's cyclotron, normally used to support PET studies, is capable of producing several light isotopes of interest, including ^{14}O, ^{13}N, ^{17}F and ^{11}C. After a short period of production, the activated target gas is sent to the 88-Inch Cyclotron, a distance of over 300 meters, via a transfer line constructed along the side of Blackberry Canyon. At building 88, the activity, in the form of $^{11}CO_2$, is cryogenically separated from the target gas and injected at a steady rate into the AECR-U, the high efficiency, high charge-state ion source for the 88-Inch Cyclotron. The entire process is automated and monitored by computer and many batches of activity are transferred per hour.

In the design of BEARS, careful attention has been paid to safety concerns and the minimization of radiation exposure to project workers and to others both on and off site. The gas capillary carrying the activity between the two buildings is contained within a 2" diameter vacuum hose. The presence of vacuum in the hose serves to verify the physical integrity of the transfer line. System interlocks on this vacuum and on other parameters would shutdown activity production should any fault be detected. No isotope produced by the project has a half-life greater than 20 minutes; all exhaust gases are held for several hours before release, allowing all activity to decay away.

The high transport speed of the activity, 15 meters/sec, means that only low radiation levels are present near the transfer line, and only during actual operation. These low levels are made negligible by burying the transfer line at the points where it is accessible to general lab personnel (mostly under parking lots).

The current ^{11}C beam has been used in support of three experiments: measurements of (^{11}C,xn) reactions on gold, fusion-fission barriers of ^{11}C on gold and platinum isotopes, and p+^{11}C elastic scattering. The latter two experiments, performed in conjunction with outside groups, are being analyzed. The first experiment, the subject of another submission to this annual report, has been completed and submitted for publication [4]. Other measurements are in progress.

† Environmental Health and Safety Division
‡ Brookhaven National Lab
§ Biomedical Isotope Facility, Life Sciences Division

1. see past annual report submissions on BEARS.
2. http://cerny3.lbl.gov/BEARS/homepage.html
3. J. Powell *et al.*, submitted to Nucl. Inst. and Meth.
4. R. Joosten *et al.*, submitted to Phys. Rev. Lett.

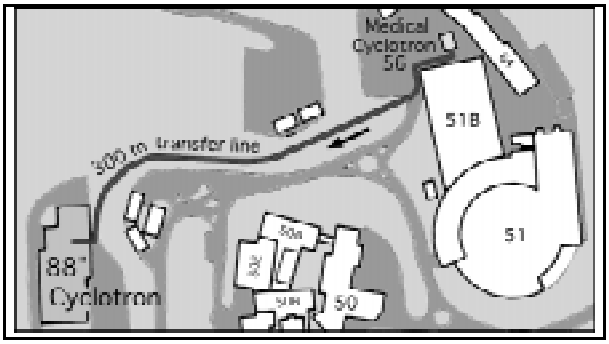

Fig. 1. Map of the BEARS transfer line.